
VANDERBILT-INGRAM CANCER CENTER

# Longitudinal Radiographic Outcomes of Vestibular Schwannoma in Single and Fractionated Stereotactic Radiosurgery

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# Background

- Following SRS, vestibular schwannomas change size, shape, and radiologic characteristics. These changes are not easily quantified, as size is difficult to track reliably using limited available spherical and non-spherical calculations, leading to excessive imaging and falsely "over-calling" progression.
- An optimal imaging interval following SRS has yet to be defined, though a typical schedule consists of imaging at 6, 12, 18, and 24 months post-SRS followed by annual scans or symptom-driven scans.
- Transient enlargement (pseudoprogression) is common and is difficult to distinguish from true progression, thus poorly interpreted imaging may lead to unnecessary re-interventions.
- There is a paucity of literature on 3D volumetric kinetics following SRS, though such data would inform a consensus on appropriate post-SRS surveillance imaging timeline.
- Our study is first to collect 3D volumetric kinetics of VS following single and fractionated SRS in contrast to extrapolations from single and two-dimensional measurements.
- We retrospectively collected volumetric kinetic data in VS patients treated with SRS over time using a target volume contouring software (MIM)
- We also tracked radiographic phenomena such as pseudoprogression and necrosis, overall treatment success rate and any failures.

# Pre-SRS Characteristics

**Table 1** Patient pretreatment clinicopathological characteristics

| Variable | One fraction, $N = 12$ | Three fractions, $N = 12$ | Five fractions, $N = 31$ | $p$-Value |
|---|---|---|---|---|
| Age | 74 (14.5) | 58.5 (17.5) | 65 (18.5) | 0.2 |
| Dose (cGy) | 1,250 (37.5) | 700 (0) | 450 (50) | 0.12 |
| Female sex | 6 (50) | 8 (66.6) | 20 (64.5) | 0.62 |
| Baseline tumor size ($cm^3$) | 0.745 (0.9) | 1.42 (2.36) | 2.13 (3.19) | **0.03** |
| Pre-RT surgery, $n$ (%) | 0 | 1 (8.3) | 5 (16.1) | 0.29 |
| Baseline necrosis (%) | 3 (25) | 6 (50) | 16 (51.6) | 0.27 |

Abbreviation: RT, radiotherapy.
Note: $p$-value significance is in bold.

Khattab et al, JNLS-B (Skull Base), 2019

# 3D Volumetric Kinetics After SRS

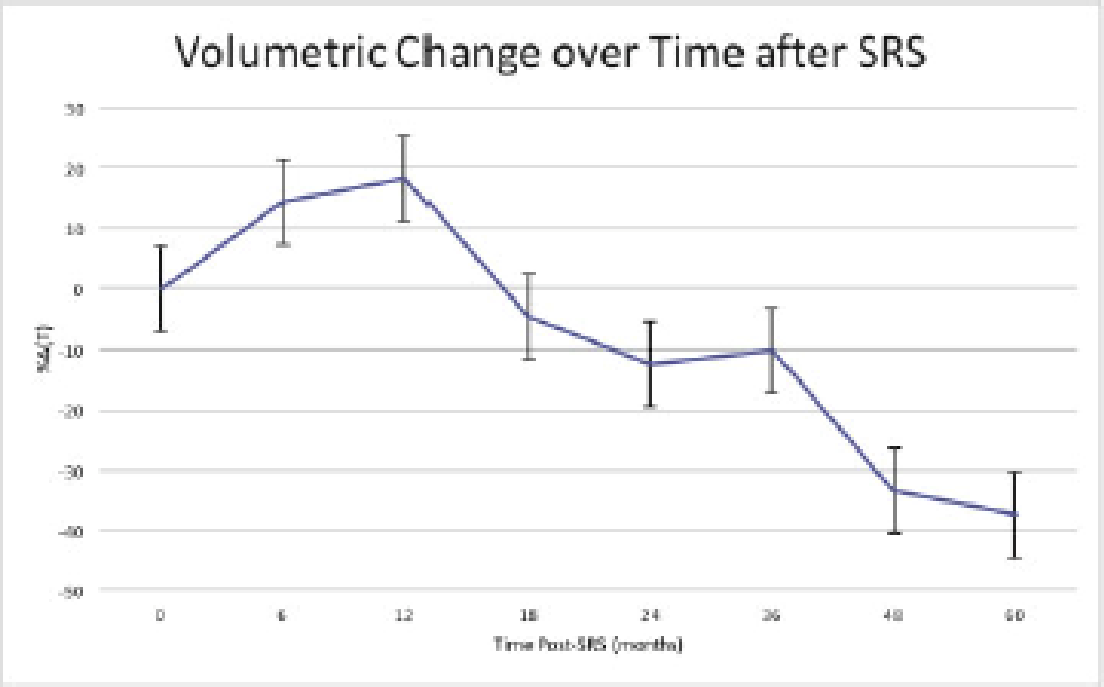
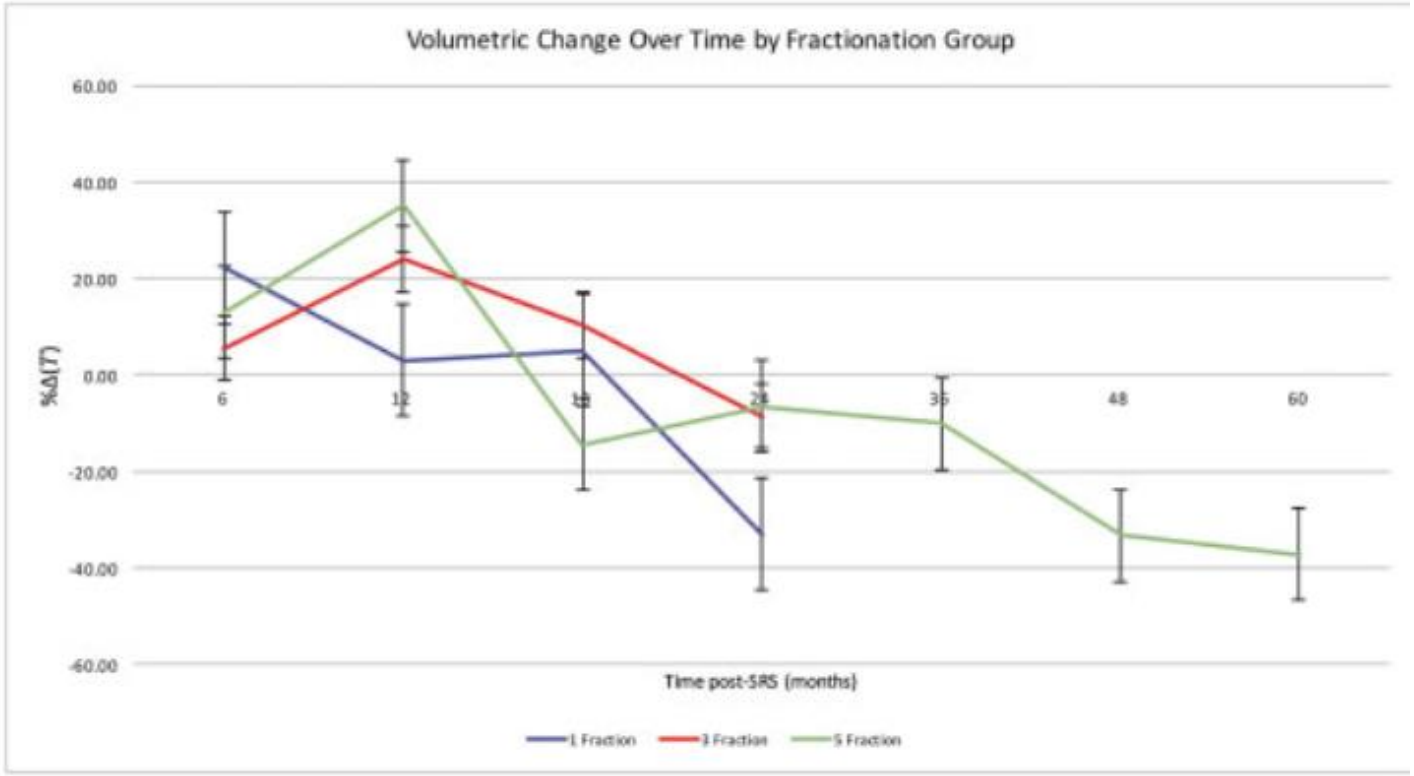



**Fig. 1** Volumetric change over time for all treatment groups. SRS, stereotactic radiosurgery.

$$\%\Delta(T) = \frac{T_1 - T_0}{T_0} * 100\%$$

Khattab et al, JNLS-B (Skull Base), 2019

# Volumetric Changes Stratified by Fractionation Scheme:




**2** Volumetric change over time after stereotactic radiosurgery (SRS) by fractionation scheme.

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# Study outcomes by fractionation scheme:

**Table 2** Study outcomes by fraction scheme

| End point | One fraction | Three fractions | Five fractions | *p*-Value |
|---|---|---|---|---|
| Pseudoprogression, *n* (%) | 3 (25%) | 3 (25%) | 11 (35%) | 0.24 |
| Salvage therapy, *n* (%) | 0(0) | 0 (0) | 2 (6.5%) | 0.44 |
| Necrosis at the last follow-up, *n* (%) | 7 (58%) | 6 (50%) | 20 (65%) | 0.67 |
| %(T) at last the follow-up compared with baseline, mean % (SD) | −12.5 (65) | −2.7 (49) | 4.7(68) | 0.42 |

Khattab et al, JNLS-B (Skull Base), 2019

Kaplan-Meier curves were generated to better delineate subclinical continuous volumetric changes with a clinically significant volume increase (probability of exceeding or equaling 25% post-SRS volume increase):

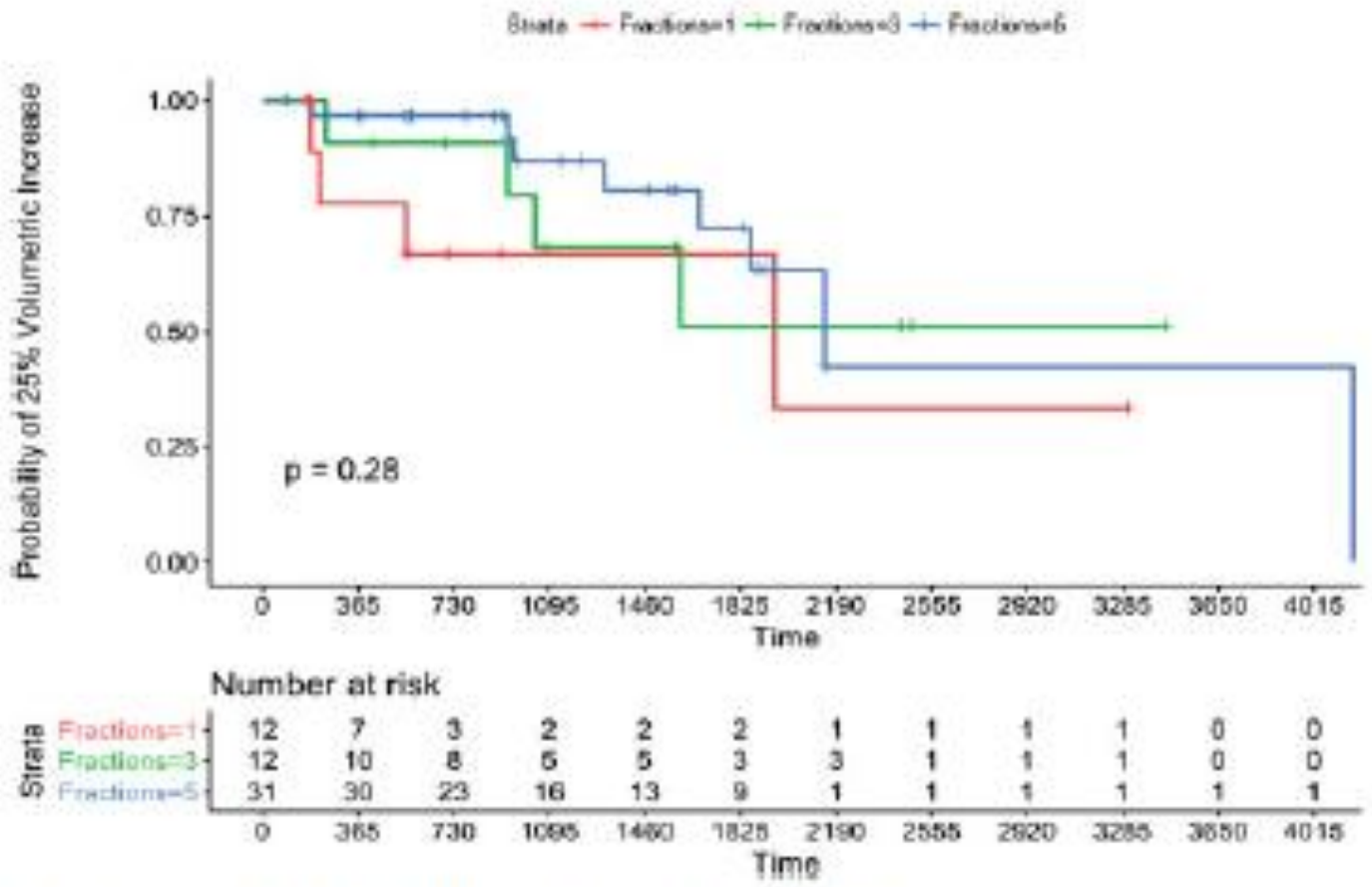


**Fig. 3** Kaplan–Meier curve demonstrating time to %() ≥ 25% for each treatment group.

Khattab et al, JNLS-B (Skull Base), 2019

# Conclusions

- We describe a reliable method using volume contouring soft-ware to track volumetric kinetics of VS following SRS
- Our findings suggest that VS volume increases in the first 12 months of treatment followed by later decline
- Further investigation is warranted regarding the utility of surveillance imaging in the early post treatment period (before 12 months) as this may overcall progression and may not be cost-effective
- Additionally, our data show very low treatment failure following SRS and a trending association between necrotic changes and small volume increase at the last follow-up, suggesting that small increases at follow-up may not be clinically relevant and may represent radiation-related changes